WHAT IS CLAIMED IS:

1. A method for achieving optical amplification of an optical signal passing through a semiconductor, the method comprising the steps of:

(a) providing a semiconductor material, said semiconductor material having a given band gap energy at a given temperature;

(b) heating said semiconductor material so as to raise at least a portion of the semiconductor material to a temperature such that the band gap energy in said portion is smaller by at least 5% than the band gap at said given temperature, the heating being performed so as to generate an inhomogeneous temperature distribution within a target volume of the semiconductor; and

(c) directing the optical signal through said target volume.

2. The method of claim 1, wherein said semiconductor material is an indirect band-gap semiconductor material.

3. The method of claim 1, wherein said semiconductor material is silicon.

4. The method of claim 3, wherein said heating is performed so as to raise at least a portion of the semiconductor material to a temperature in the range of between 200°C and 1000°C above an ambient temperature.

5. The method of claim 1, wherein said heating is performed so as to raise at least a portion of the semiconductor material to a temperature such that the band gap energy in said portion is smaller by at least 10% than the given band gap energy.

6. The method of claim 1, wherein said heating is performed by directing laser radiation onto a region of said semiconductor material.

7. The method of claim 6, wherein said laser radiation is directed onto a region of said semiconductor material coated with a compound having lower reflectivity than an exposed surface of said semiconductor material.

8. The method of claim 1, wherein the optical signal is directed into a region of said semiconductor material coated with a compound having higher reflectivity than an exposed surface of said semiconductor material so as to cause reflection of the optical signal so as to pass through said target volume a plurality of times.

9. The method of claim 1, wherein said heating is performed by directing a source of microwave radiation into a region of said semiconductor material.

10. The method of claim 1, wherein said heating is performed by directing heat from a non-coherent light source onto a region of said semiconductor material.

11. The method of claim 1, wherein said heating is performed by passing an electric current through a resistive load associated with said semiconductor material.

12. The method of claim 1, wherein at least said target volume of the semiconductor forms part of an optical waveguide, said step of directing the optical signal being performed by directing the optical signal along said optical waveguide.

13. The method of claim 1, wherein said semiconductor material is silicon doped with at least one element chosen from the group comprising: Gold, Silver, Platinum, Iron, Copper, Zinc, Cobalt, Tellurium, Mercury, Nickel, Sulfur and Manganese.

14. An apparatus for achieving optical amplification of an optical signal, the apparatus comprising:

(a) a body of semiconductor material including a target volume, said semiconductor material having a given band gap energy at room temperature;

(b) a heating arrangement operatively associated with said body of semiconductor material for raising at least a portion of the semiconductor material to a temperature such that the band gap energy in said portion is smaller by at least 5% than the band gap at said given temperature, the heating being performed so as to generate an inhomogeneous temperature distribution within a target volume of the semiconductor; and

(c) an optical arrangement for directing an optical signal through said target volume.

15. The apparatus of claim 14, wherein said semiconductor material is an indirect band-gap semiconductor material.

16. The apparatus of claim 14, wherein said body of semiconductor material is formed from silicon.

17. The apparatus of claim 16, said heating is performed so as to raise at least a portion of the semiconductor material to a temperature in the range of between 200°C and 1000°C above an ambient temperature.

18. The apparatus of claim 14, wherein said heating arrangement is configured to raise at least a portion of the semiconductor material to a temperature such that the band gap energy in said portion is smaller by at least 10% than the given band gap energy.

19. The apparatus of claim 14, wherein said heating arrangement includes a laser for directing radiation onto a region of said body.

20. The apparatus of claim 19, wherein said laser radiation is directed onto a region of said semiconductor material coated with a compound having lower reflectivity than an exposed surface of said semiconductor material.

21. The apparatus of claim 14, wherein a region of said body of semiconductor material is coated with a compound having higher reflectivity than an exposed surface of said semiconductor material so as to cause reflection of the optical signal so as to pass through said target volume a plurality of times.

22. The apparatus of claim 14, wherein said heating arrangement includes a source of microwave radiation for directing microwave radiation into a region of said body.

23. The apparatus of claim 14, wherein said heating arrangement includes an arrangement for directing heat from a non-coherent light source onto a region of said semiconductor material.

24. The apparatus of claim 14, wherein said heating arrangement includes an electric circuit for passing an electric current through a load associated with said body.

25. The apparatus of claim 14, wherein said target volume forms part of an optical waveguide formed in said body of semiconductor material, said optical arrangement including an optical interface for introducing said optical signal into said optical waveguide.

26. The apparatus of claim 14, wherein said semiconductor material is silicon doped with at least one element chosen from the group comprising: Gold, Silver, Platinum, Iron, Copper, Zinc, Cobalt, Tellurium, Mercury, Nickel, Sulfur and Manganese.

27. A method for achieving optical amplification of an optical signal passing through indirect-gap semiconductor, the method comprising the steps of:

(a) providing a body of the indirect-gap semiconductor doped with at least one element so as to generate at least one added energy level at a known energy lying within the energy band-gap of the semiconductor, said added energy level enabling an energy transition between said added energy level and an energy band of the semiconductor corresponding to generation of a photon of a given wavelength;

(b) irradiating a target region of said body of semiconductor with optical illumination of a wavelength shorter than said given wavelength; and

(c) directing an optical signal of said given wavelength through said target region.

28. The method of claim 27, wherein said illumination has a wavelength no greater than a wavelength of a photon corresponding to the transition between the conduction gap and the valence band in said semiconductor.

29. The method of claim 27, wherein said at least one element is chosen from the group comprising: Gold, Silver, Platinum, Iron, Copper, Zinc, Cobalt, Tellurium, Mercury, Nickel, Sulfur and Manganese.

30. The method of claim 27, wherein said at least one element is chosen from the group comprising: Gold, Silver and Platinum.

31. The method of claim 27, wherein said at least one element includes Gold.

32. The method of claim 31, wherein said given wavelength is in the range of 1.2-2.2 micrometers.

33. The method of claim 27, wherein said irradiating is performed using a pulsed laser source.

34. The method of claim 27, wherein said irradiating is performed using a substantially continuously irradiating laser source.

35. The method of claim 27, wherein said target region lies at least partially in an optical waveguide formed in said body of semiconductor.

36. The method of claim 27, wherein said indirect-gap semiconductor is silicon.

37. A method for achieving optical amplification of an optical signal passing through an indirect-gap semiconductor, the method comprising the steps of:

(a) providing a body of the indirect-gap semiconductor doped with at least one element so as to generate at least one added energy level at a known energy lying within the energy band-gap of the semiconductor, said added energy level enabling an energy transition between said added energy level and an energy band of the semiconductor corresponding to generation of a photon of a given wavelength;

(b) performing current injection into at least a target region of said body of semiconductor; and

(c) directing an optical signal of said given wavelength through said target region.

38. The method of claim 37, wherein said at least one element is chosen from the group comprising: Gold, Silver, Platinum, Iron, Copper, Zinc, Cobalt, Tellurium, Mercury, Nickel, Sulfur and Manganese.

39. The method of claim 37, wherein said at least one element is chosen from the group comprising: Gold, Silver and Platinum.

40. The method of claim 37, wherein said at least one element includes Gold.

41. The method of claim 37, wherein said indirect-gap semiconductor is silicon.